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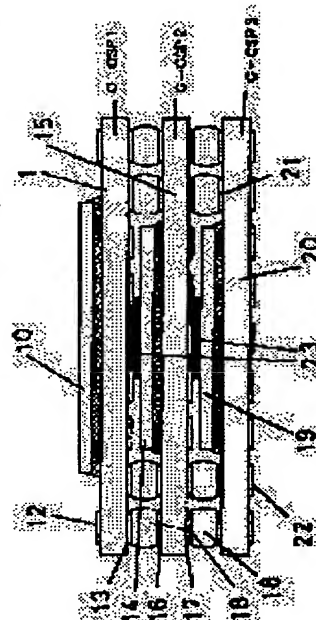
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## (54) SEMICONDUCTOR DEVICE AND MANUFACTURING METHOD THEREOF

**(57)Abstract:**

**PROBLEM TO BE SOLVED:** To easily provide a back-biased MCM to reduce the process cost.

**SOLUTION:** The semiconductor device comprises a single or a plurality of semiconductor elements 14, a plurality of semiconductor carriers 11 and 15, a conductive adhesive connecting semiconductor element electrodes on the upper surface of the carrier 15 to projecting electrodes of the element 14, solder balls 18 electrically connecting front-side external electrodes 16 on the upper surface of the carrier 15 to back-side external electrodes 13 on the bottom of the carrier 11, and conductive spring members 23 electrically connecting the back side of the element 14 connected to the carrier 15 to ground terminals of the electrodes 13. By biasing the members 23, back-biased MCM can be provided without a high-cost equipment step and a complicated wet step.



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CLAIMS

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## [Claim(s)]

[Claim 1] 1 or two or more semiconductor devices which have two or more projection electrodes, Two or more semi-conductor carriers which become a base from an insulating base with the rear-face external electrode which has an electrode for semiconductor devices corresponding to the projection electrode of said semiconductor device, and the surface external electrode formed in the location where said semiconductor device does not exist on the top face, and was arranged in the shape of a grid, The electroconductive glue which connected the electrode for semiconductor devices on said top face of a semi-conductor carrier, and the projection electrode of said semiconductor device, The thermosetting resin which is carrying out the restoration coat of said semiconductor device, gap of said semi-conductor carrier, and periphery of said semiconductor device, The charge of connection lumber which connected electrically the surface external electrode on said one top face of a semi-conductor carrier, and the rear-face external electrode at said base of a semi-conductor carrier of another side, The semiconductor device equipped with the conductive ingredient which connected electrically the grand terminal of the rear-face external electrodes at the tooth back of said semiconductor device linked to said one semi-conductor carrier, and said base of a semi-conductor carrier of another side.

[Claim 2] The semiconductor device according to claim 1 whose charge of connection lumber is a solder ball.

[Claim 3] The semiconductor device according to claim 1 with which a conductive ingredient has spring nature or elasticity.

[Claim 4] The semiconductor device according to claim 1, 2, or 3 with which it was placed between the whole gaps of one semi-conductor carrier and the semi-conductor carrier of another side by the resin ingredient only as for near the charge of connection lumber which connects the surface external electrode on one top face of a semi-conductor carrier, and the rear-face external electrode at the base of a semi-conductor carrier of another side.

[Claim 5] The process which forms a projection electrode on the component electrode of a semiconductor device, and the process which supplies electroconductive glue to said projection electrode, The process which connects the projection electrode with which said electroconductive glue on said semiconductor device was supplied, and said electrode for semiconductor devices formed in the semi-conductor carrier top face which consists of an insulating base, and hardens said electroconductive glue, The process which pours in and carries out heat curing of the thermosetting resin to the clearance and periphery which were formed between said semiconductor devices and said semi-conductor carriers, The process which carries a conductive ingredient in said semiconductor device tooth back, and the surface external electrode on said top face of a semi-conductor carrier and the rear-face external electrode at another base of a semi-conductor carrier are electrically connected at the charge of connection lumber. The manufacture approach of a semiconductor device including the process which connects said conductive ingredient to the grand terminal of the rear-face external electrodes at another base of a semi-conductor carrier electrically.

[Claim 6] A connection ingredient is the manufacture approach of the semiconductor device according to claim 5 which consists of solder printed to the surface external electrode on the top face of a semi-conductor carrier, and a solder ball carried in the rear-face external electrode at another base of a semi-conductor carrier.

[Claim 7] A conductive ingredient is the manufacture approach of a semiconductor device according to claim 5 of having spring nature or elasticity.

[Claim 8] The manufacture approach of a semiconductor device according to claim 5 of pouring thermosetting resin into the gap of a semi-conductor carrier other than said semi-conductor carrier, and having the process to stiffen after connecting a semi-conductor carrier other than a semi-conductor carrier.

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## DETAILED DESCRIPTION

## [Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention protects the integrated-circuit section of a semiconductor device, and secures the electrical installation of an external device and a semiconductor device to stability, enables further highest-density mounting, and relates to the semiconductor device used for industrial-use electronics equipments, such as information communication equipment, electronic equipment for clerical work, home electronic equipment, a measuring device, and an assembling robot, medical-application electronic equipment, an electronic toy, etc., and its manufacture approach about the multi chip module (henceforth MCM) which especially carries two or more semiconductor devices.

[0002]

[Description of the Prior Art] The conventional semiconductor device is explained below. The structure of MCM which needs the conventional back bias first is explained. Drawing 12 and drawing 13 are the top views and sectional views having shown the structure of MCM which needs the conventional back bias. The MCM consists of three chips and forms the metal coat for back bias in the tooth back of one chip in it. Three component electrodes 45, 46, and 47 of semiconductor devices 42, 43, and 44 are electrically connected in the solder bump 50 grade to the electrode 49 for components of the semi-conductor carrier 48, and impregnation hardening of the closure resin 51 is carried out in the gap of each semiconductor device and the semi-conductor carrier 48 (flip chip mounting). Moreover, the GND electrode (terminal) 52 is shown in the front face of the semi-conductor carrier 48, and the metal coat 53 is formed so that the rear face of this GND terminal 52 and a semiconductor device 43 may be connected electrically.

[0003] Next, the manufacture approach of MCM which needs the conventional back bias is explained. Drawing 14 (a) - (c) and drawing 15 (d) - (f) is the process sectional view having shown the production process flow of MCM which needs the conventional back bias.

[0004] The solder bump 50 is formed on the component electrode 45 of semiconductor devices 42 and 44, and 46 (drawing 14 (a)). Alignment of the semi-conductor carrier 48 is carried out to each semiconductor device, and a soldered joint is performed by a reflow etc. after loading (drawing 14 (b)). The gap of each semiconductor device and the semi-conductor carrier 48 is made to pour in and harden closure resin 51 (drawing 14 (c)). The resist mask 55 is formed in the side front of MCM so that it may have opening which the GND terminal 52 on the tooth back of a semiconductor device 43 and semi-conductor carrier 48 side front which needs back bias connects electrically (drawing 15 (d)). The metal coat 56 is formed in the side front of MCM by a spatter etc. (drawing 15 (e)). The resist mask 55 formed in the next is removed (drawing 15 (f)). The metal coat 53 will be formed so that the semiconductor device 43 and the GND terminal 52 of semi-conductor carrier 48 front face which need back bias may be connected electrically above.

[0005] By taking the above processes, MCM containing the semiconductor device which makes back bias possible can be manufactured.

[0006]

[Problem(s) to be Solved by the Invention] However, in the conventional MCM, in order to take back bias, a metal coat is formed in the whole MCM or its part, but since the metal vacuum evaporation by the formation of a mask by a resist etc., a spatter, etc. is needed as a process, if it is an assembler, it is quite special, and a high cost facility process and a complicated wet process are needed, and it has become the big cause of a cost rise as the result.

[0007] Therefore, it is offering the semiconductor device which can take back bias easily, and its manufacture approach, the object of this invention solving said technical problem, and taking the gestalt of MCM.

[0008]

[Means for Solving the Problem] In order to solve said technical problem the semiconductor device of this invention according to claim 1 1 or two or more semiconductor devices which have two or more projection electrodes, Two or more semi-conductor carriers which become a base from an insulating base with the rear-face external electrode which has an electrode for semiconductor devices corresponding to the projection electrode of a semiconductor device, and the surface external electrode formed in the location where a semiconductor device does not exist on the top face, and was arranged in the shape of a grid, The electroconductive glue which connected the electrode for semiconductor devices on the top face of a semi-conductor carrier, and the projection electrode of a semiconductor device, The thermosetting resin which is carrying out the restoration coat of a semiconductor device, the gap of a semi-conductor carrier, and the periphery of a semiconductor device, The charge of connection

lumber which connected electrically the surface external electrode on one top face of a semi-conductor carrier, and the rear-face external electrode at the base of a semi-conductor carrier of another side, It had the conductive ingredient which connected electrically the grand terminal of the rear-face external electrodes at the tooth back of a semiconductor device, and the base of a semi-conductor carrier of another side linked to one semi-conductor carrier.

[0009] Thus, since the electrode for semiconductor devices on one top face of a semi-conductor carrier and the projection electrode of a semiconductor device were connected with electroconductive glue, the height dimension of the semiconductor device from one semi-conductor carrier top face to a semiconductor device tooth back can be made small. In connection with this, the height of the charge of connection lumber which connected electrically the surface external electrode on one top face of a semi-conductor carrier and the rear-face external electrode at the base of a semi-conductor carrier of another side becomes larger enough than the above-mentioned height dimension of a semiconductor device. For this reason, the semi-conductor carrier of another side is located in the tooth-back side of a semiconductor device. By connecting electrically the grand terminal of the rear-face external electrodes at the tooth back of a semiconductor device, and the base of a semi-conductor carrier of another side linked to one semi-conductor carrier with a conductive ingredient In MCM which needs back bias, it made it possible to take back bias structure by low cost, without needing complicated processing processes, such as masking by a resist etc., and formation of the metal coat by vacuum deposition.

[0010] In claim 1, the charge of connection lumber of a semiconductor device according to claim 2 is a solder ball. Thus, since the charge of connection lumber is a solder ball, it becomes advantageous, when securing height to form the solder ball made from elevated-temperature solder.

[0011] In claim 1, as for a semiconductor device according to claim 3, a conductive ingredient has spring nature or elasticity. Thus, since a conductive ingredient has spring nature or elasticity, you can make it fully electrically stabilized by making it intervene between a semiconductor device tooth back and a semi-conductor carrier side in the condition of having sufficient elasticity tearing the oxide film on the rear face of a semiconductor device.

[0012] Only as for near the charge of connection lumber where a semiconductor device according to claim 4 connects the surface external electrode on one top face of a semi-conductor carrier, and the rear-face external electrode at the base of a semi-conductor carrier of another side in claims 1, 2, or 3, it was placed between the whole gaps of one semi-conductor carrier and the semi-conductor carrier of another side by the resin ingredient. Thus, since it was placed between the whole gaps of one semi-conductor carrier and the semi-conductor carrier of another side by the resin ingredient, near the charge of connection lumber which connects the surface external electrode on one top face of a semi-conductor carrier and the rear-face external electrode at the base of a semi-conductor carrier of another side will be in the condition that the connection was stabilized, and its dependability will improve.

[0013] The process at which the manufacture approach of a semiconductor device according to claim 5 forms a projection electrode on the component electrode of a semiconductor device, The process which supplies electroconductive glue to a projection electrode, and the projection electrode with which the electroconductive glue on a semiconductor device was supplied, The process which connects the electrode for semiconductor devices formed in the semi-conductor carrier top face which consists of an insulating base, and hardens electroconductive glue, The process which pours in and carries out heat curing of the thermosetting resin to the clearance and periphery which were formed between the semiconductor device and the semi-conductor carrier, The process which carries a conductive ingredient in a semiconductor device tooth back, and the surface external electrode on the top face of a semi-conductor carrier and the rear-face external electrode at another base of a semi-conductor carrier are electrically connected at the charge of connection lumber. The process which connects a conductive ingredient to the grand terminal of the rear-face external electrodes at another base of a semi-conductor carrier electrically is included.

[0014] Thus, since the projection electrode with which the electroconductive glue on a semiconductor device was supplied, and the electrode for semiconductor devices formed in the semi-conductor carrier top face are connected and electroconductive glue is hardened, the height dimension of the semiconductor device from a semi-conductor carrier top face to a semiconductor device tooth back can be made small. Therefore, in case a conductive ingredient is carried in a semiconductor device tooth back and the surface external electrode on the top face of a semi-conductor carrier and the rear-face external electrode at another base of a semi-conductor carrier are electrically connected at the charge of connection lumber, the height of this charge of connection lumber becomes larger enough than the above-mentioned height dimension of a semiconductor device. Since another semi-conductor carrier is located and the grand terminal of the rear-face external electrodes at the base of a semi-conductor carrier other than the tooth back of a semiconductor device can be electrically connected to the tooth-back side of a semiconductor device with a conductive ingredient by this in case it is made the structure to which bias is made to add, without it needs the high process of facility cost like complicated process metallurgy group vacuum evaporation of masking etc. — an easy and cheap process — \*\*, since it can carry out and a device is accumulated still in three dimension MCM which carried the semiconductor device with very [ in area ] high packaging density can be offered.

[0015] The manufacture approach of a semiconductor device according to claim 6 consists of solder which prints a connection ingredient to the surface external electrode on the top face of a semi-conductor carrier, and a solder ball which carries in the rear-face external electrode at another base of a semi-conductor carrier in claim 5. Thus, since a connection ingredient consists of solder printed to the surface external electrode on the top face of a semi-

conductor carrier, and a solder ball carried in the rear-face external electrode at another base of a semi-conductor carrier, it is connectable with heating which is extent which the solder which printed fuses by applying sufficient pressure for a solder ball and the solder for printing touching. Moreover, it becomes advantageous, when securing height to form the solder ball made from elevated-temperature solder.

[0016] As for a conductive ingredient, the manufacture approach of a semiconductor device according to claim 7 has spring nature or elasticity in claim 5. Thus, since a conductive ingredient has spring nature or elasticity, it can fully be electrically stabilized by making it intervene between a semiconductor device tooth back and a semi-conductor carrier side in the condition of having sufficient elasticity tearing the oxide film on the rear face of a semiconductor device.

[0017] In claim 5, after the manufacture approach of a semiconductor device according to claim 8 connects a semi-conductor carrier other than a semi-conductor carrier, it pours thermosetting resin into the gap of a semi-conductor carrier other than a semi-conductor carrier, and has the process to stiffen. Thus, since thermosetting resin is poured into the gap of a semi-conductor carrier other than a semi-conductor carrier and it has the process to stiffen after connecting a semi-conductor carrier other than a semi-conductor carrier, it will be in the condition that the connection was stabilized and dependability will improve.

[0018]

[Embodiment of the Invention] The gestalt of implementation of the 1st of this invention is explained based on drawing 1 - drawing 7. The gestalt of the 1st operation takes the structure of MCM by accumulating each semiconductor device on three-step structure fundamentally. Drawing 1 is a sectional view when the structure of three steps of MCM of the semiconductor device of the gestalt of implementation of the 1st of this invention being shown, and cutting drawing 2 with B1-B-2. The top view and drawing 4 which show the structure (C-CSP is called henceforth) of each semiconductor device where drawing 2 constitutes the top view of MCM of three-step structure, and drawing 3 constitutes the semiconductor device of the gestalt of implementation of this invention are a sectional view when cutting drawing 3 with A1-A2.

[0019] 1 or two or more semiconductor devices 1 in which this semiconductor device has two or more projection electrodes (Au bump 5) as shown in drawing 1 - drawing 4, Two or more semi-conductor carriers 3 which become a base from an insulating base with the rear-face external electrode 9 which has the electrode 4 for semiconductor devices corresponding to the projection electrode 5 of a semiconductor device 1, and the surface external electrode 8 formed in the location where a semiconductor device 1 does not exist on the top face, and was arranged in the shape of a grid. It has the electroconductive glue 6 which connected the electrode 4 for semiconductor devices of semi-conductor carrier 3 top face, and the projection electrode 5 of a semiconductor device 1, and thermosetting resin (closure resin 7) which is carrying out the restoration coat of a semiconductor device 1, the gap of the semi-conductor carrier 3, and the periphery of a semiconductor device 1. Moreover, it has the conductive ingredient (conductive spring material 23) which connected electrically the grand terminal of the rear-face external electrodes 13 of the tooth back of a semiconductor device 14, and semi-conductor carrier 11 base of another side which connected the surface external electrode 16 of one semi-conductor carrier 15 top face, and the rear-face external electrode 13 of semi-conductor carrier 11 base of another side to the electrically connected charge of connection lumber (solder ball 18), and one semi-conductor carrier 15.

[0020] The connection structure of the semiconductor device of C-CSP (LGA which makes a ceramic INTAPOZA), and a semi-conductor carrier which constitutes MCM in this operation gestalt using drawing 3 and drawing 4 first is explained. The component electrode 2 of a semiconductor device 1 and the electrode 4 for components of the semi-conductor carrier 3 are electrically connected through the Au bump 5 and electroconductive glue 6, and impregnation hardening of the closure resin 7 is carried out further in the gap of a semiconductor device 1 and the semi-conductor carrier 3 (this connection type is henceforth called a SBB method). At this time, the electrode 4 for components of the semi-conductor carrier 3 is electrically connected with the surface external electrode 8 of the semi-conductor carrier 3, and the rear-face external electrode 9 if needed on circuitry. Furthermore, a semiconductor device 1 has thickness smaller enough than the height of the connection ingredient used when carrying out a laminating.

[0021] Next, the structure of MCM of 3 tiering in this operation gestalt is explained using drawing 1 and drawing 2. In drawing 1 and drawing 2, in the semiconductor device of an upper case, C-CSP1 (the semiconductor device 10 which does not need rear-face potential is carried), and the middle are made into C-CSP2 (the semiconductor device 14 which needs rear-face potential is carried), the lower berth is made into C-CSP3 (the semiconductor device 19 which needs rear-face potential is carried), and the semi-conductor carrier is connected with the semiconductor device according to connection structure [ in / in all C-CSP / drawing 3 and drawing 4 ]. A part for periphery 2 train and the surface external electrode 21 of the semi-conductor carrier 20 in C-CSP3 are further connected [ among the rear-face external electrodes 13 of the semi-conductor carrier 11 in C-CSP1 ] with the solder ball 18, respectively among the rear-face external electrodes 17 of the semi-conductor carrier [ in / in a part for periphery 2 train, and the surface external electrode 16 of the semi-conductor carrier 15 in C-CSP2 / C-CSP2 ] 15. At this time, the height of the solder ball 18 is fully larger than the distance from the semi-conductor carrier top face in each C-CSP to a semiconductor device tooth back, and it becomes advantageous to form the solder ball made from elevated-temperature solder for that purpose. Moreover, the tooth back of the GND terminal of the rear-face external electrodes 13 of the semi-conductor carrier 11 in C-CSP1 and the semiconductor device 14 in C-CSP2 is electrically connected by the conductive spring material (metal) 23, and the tooth back of the GND terminal of the rear-face external electrodes 17 of the semi-conductor carrier 15 in C-CSP2 and the

semiconductor device 19 of C-CSP3 is further connected electrically by the conductive spring material 23. You can make it fully electrically stabilized by making it intervene between each semiconductor device 14, 19 tooth backs, and the semi-conductor carrier 11 and 15 rear faces in the condition of having sufficient elastic force breaking the silicon oxide of a semiconductor device 14 and 19 tooth backs for the conductive spring material 23 at this time. Moreover, even if this makes the metal thin film form in the tooth back of semiconductor devices 14 and 19 beforehand, it can acquire effectiveness sufficient by smaller elastic force. In addition, as an example of the conductive spring material 23, there are a copper system alloy with low electric resistance (phosphor bronze (91.7Cu-8.2Sn), brass (62.3Cu-37.0Zn), beryllium copper, nickel silver), other cobalt system alloys, a nickel system alloy, etc.

[0022] Next, the manufacture approach of the three-step structure MCM in the 1st operation gestalt is explained using drawing 5 and drawing 7. The process sectional view in which drawing 5 shows the manufacture approach of each semiconductor device (C-CSP) of the gestalt of implementation of this invention, drawing 6, and drawing 7 are the process sectional views showing the manufacture approach of three steps of MCM of the gestalt implementation of the 1st this invention.

[0023] The manufacture approach of each C-CSP is first explained using drawing 5. The Au bump 5 is formed on the component electrode 2 of a semiconductor device 1 (drawing 5 (a)). Next, form the electroconductive glue film 25 which has uniform thickness to the imprint pan 24 which has sufficient surface smoothness, the Au bump 5 of a semiconductor device 1 is made immersed in the electroconductive glue film 25 by face down, and the Au bump 5 is made to imprint the electroconductive glue 6 of optimum dose (drawing 5 (b)). Location \*\*\*\*\* of a semiconductor device 1 and the semi-conductor carrier 3 is carried out so that the Au bump 5 and the electrode 4 for components of the semi-conductor carrier 3 may be connected through electroconductive glue 6, and heat curing of the electroconductive glue 6 after mounting is carried out (drawing 5 (c)). Next, it pours in and the gap of the semi-conductor carrier 3 is made to carry out heat curing of the closure resin 7 to a semiconductor device 1 (drawing 5 (d)).

[0024] Next, the manufacture approach of MCM is explained using drawing 6 and drawing 7. The solder ball 18 is formed in the rear-face external electrode 13 of the semi-conductor carrier 11 in C-CSP1, and the rear-face external electrode 17 in the semi-conductor carrier 15 in C-CSP2 (drawing 6 (a)). As an approach of forming a solder ball, print processes or a ball mounting method is used. Next, solder 27 is printed on the surface external electrode 21 of the semi-conductor carrier 20 in C-CSP3 the surface external electrode 16 top of the semi-conductor carrier 15 in C-CSP2 (drawing 6 (b)). By using what has the melting point lower than a solder ball as solder to print, the height of a solder ball can be earned and it is advantageous. Next, the conductive spring material 23 is put on the tooth back of a semiconductor device 14 in C-CSP2, and the tooth back of the semiconductor device 21 in C-CSP3 (drawing 7 (c)). At this time, this conductive spring material 23 puts only on a GND terminal in a location which is connected only to a GND terminal again among the rear-face external terminals 17 of the semi-conductor carrier 15 in C-CSP2 among the rear-face external electrodes 13 of the semi-conductor carrier 11 in C-CSP1. Finally, C-CSP2 is carried out at C-CSP1, alignment loading of C-CSP3 is carried out at C-CSP2, and MCM is formed by applying sufficient pressure 28 for each solder ball 18 and the solder 27 for printing meeting with heating which is extent which the solder 27 which printed fuses (drawing 7 (d)). It enables this to give sufficient elastic force to perform electrical installation to the conductive spring material 23 at stability.

[0025] By taking the structure and the manufacture approach of MCM in the 1st operation gestalt as mentioned above, the semiconductor device to which the rear face of a semiconductor device can be made to carry out the load of the bias stably, and its manufacture approach can be offered, without using the complicated process of mask formation or its exfoliation, and the high process of facility cost called metal vacuum evaporations.

[0026] Moreover, this structure is the range possible in circuit design, each semiconductor device in the 1st operation gestalt can be accumulated innumerable, and it is possible to carry out the modularization of many semiconductor devices to a certain fixed flat surface.

[0027] The gestalt of implementation of the 2nd of this invention is explained based on drawing 8 - drawing 11. The top view and drawing 9 drawing 8 explains the structure of MCM of 2 tiering in the gestalt of implementation of the 2nd of this invention to be are a sectional view when cutting drawing 8 with C1-C2.

[0028] As shown in drawing 8 and drawing 9, the configuration of this semiconductor device arranges C-MCM which carried two semiconductor devices 29 and 30 which do not need C-CSP4 which carried one semiconductor device 34 which needs rear-face bias for the lower berth on the upper case. Moreover, connection of the semiconductor device in C-CSP4 and C-MCM and a semi-conductor carrier is made by the SBB method. The surface external electrode 36 of the semi-conductor carrier 35 in C-CSP4 to which periphery 2 train is located in the lower berth is connected with the copper ball 38 by solder 39 and 40 among the rear-face external electrodes 33 of the semi-conductor carrier 31 in C-MCM located in an upper case. Moreover, the GND terminal of the rear-face external electrodes 33 of the semi-conductor carrier 31 in C-MCM located in the tooth back and upper case of a semiconductor device 34 in C-CSP4 located in the lower berth is electrically connected by the anisotropy conductive liner sheet 41. And impregnation hardening of the closure resin 51 is carried out in the gap of C-MCM of an upper case, and C-CSP4 of the lower berth.

[0029] Next, the manufacture approach of MCM in the 2nd operation gestalt is explained using drawing 10 and drawing 11. Drawing 10 and drawing 11 are the process sectional views showing the manufacture approach of two steps of MCM of the gestalt implementation of the 2nd this invention. Solder 39 is printed after manufacture by SBB connection to the rear-face external electrode 32 of the semi-conductor carrier [ in / for C-MCM / C-MCM ]



31, and the copper ball 38 is connected for the copper ball 38 by a reflow after loading etc. ( drawing 10 (a)). Next, the anisotropy conductive liner sheet 41 is stuck on the tooth back of a semiconductor device 34 after printing solder 40 to the surface external electrode 36 of the semi-conductor carrier 35 in C-CSP4 ( drawing 10 (b)) ( drawing 11 (c)). Next, alignment of C-MCM and C-CSP4 is carried out, and C-MCM is mounted on C-CSP4. At this time, application of pressure and heating are carried out, and the tooth back of the semiconductor device 34 of C-CSP4 and the GND terminal of the rear-face external electrodes 33 of C-MCM are connected electrically ( drawing 11 (d)). The surface external electrode 36 of the semi-conductor carrier 35 in C-CSP4 is electrically connected with the solder ball 38 with solder 40 after that by the reflow etc. Next, heat curing is carried out in oven etc. after pouring in the resin 42 of epoxy nature, heating in the gap of C-CSP4 and C-MCM ( drawing 11 (e)). [0030] According to the 2nd operation gestalt, the semiconductor device which needs rear-face bias by the simple approach like MCM in the 1st operation gestalt can be MCM-ized as mentioned above. Furthermore with the 2nd operation gestalt, the gap of each C-CSP or C-MCM can be provided with more reliable MCM by carrying out impregnation hardening of the resin.

[0031]

[Effect of the Invention] According to the semiconductor device of this invention according to claim 1, since the electrode for semiconductor devices on one top face of a semi-conductor carrier and the projection electrode of a semiconductor device were connected with electroconductive glue, the height dimension of the semiconductor device from one semi-conductor carrier top face to a semiconductor device tooth back can be made small. In connection with this, the height of the charge of connection lumber which connected electrically the surface external electrode on one top face of a semi-conductor carrier and the rear-face external electrode at the base of a semi-conductor carrier of another side becomes larger enough than the height dimension of a semiconductor device. For this reason, the semi-conductor carrier of another side is located in the tooth-back side of a semiconductor device. By connecting electrically the grand terminal of the rear-face external electrodes at the tooth back of a semiconductor device, and the base of a semi-conductor carrier of another side linked to one semi-conductor carrier with a conductive ingredient In MCM which needs back bias, it made it possible to take back bias structure by low cost, without needing complicated processing processes, such as masking by a resist etc., and formation of the metal coat by vacuum deposition.

[0032] In claim 2, since the charge of connection lumber is a solder ball, it becomes advantageous, when securing height to form the solder ball made from elevated-temperature solder.

[0033] Since a conductive ingredient has spring nature or elasticity, you can make it fully electrically stabilized in claim 3 by making it intervene between a semiconductor device tooth back and a semi-conductor carrier side in the condition of having sufficient elasticity tearing the oxide film on the rear face of a semiconductor device.

[0034] In claim 4, since it was placed between the whole gaps of one semi-conductor carrier and the semi-conductor carrier of another side by the resin ingredient, near the charge of connection lumber which connects the surface external electrode on one top face of a semi-conductor carrier and the rear-face external electrode at the base of a semi-conductor carrier of another side will be in the condition that the connection was stabilized, and its dependability will improve.

[0035] Since according to the manufacture approach of the semiconductor device this invention according to claim 5 the projection electrode with which the electroconductive glue on a semiconductor device was supplied, and the electrode for semiconductor devices formed in the semi-conductor carrier top face are connected and electroconductive glue is hardened, the height dimension of the semiconductor device from a semi-conductor carrier top face to a semiconductor device tooth back can be made small. Therefore, in case a conductive ingredient is carried in a semiconductor device tooth back and the surface external electrode on the top face of a semi-conductor carrier and the rear-face external electrode at another base of a semi-conductor carrier are electrically connected at the charge of connection lumber, the height of this charge of connection lumber becomes larger enough than the above-mentioned height dimension of a semiconductor device. Since another semi-conductor carrier is located and the grand terminal of the rear-face external electrodes at the base of a semi-conductor carrier other than the tooth back of a semiconductor device can be electrically connected to the tooth-back side of a semiconductor device with a conductive ingredient by this in case it is made the structure to which bias is made to add, without it needs the high process of facility cost like complicated process metallurgy group vacuum evaporations of masking etc. — an easy and cheap process — \*\*, since it can carry out and a device is accumulated still in three dimension MCM which carried the semiconductor device with very [ in area ] high packaging density can be offered.

[0036] Since it consists of solder which prints a connection ingredient in claim 6 to the surface external electrode on the top face of a semi-conductor carrier, and a solder ball carried in the rear-face external electrode at another base of a semi-conductor carrier, it is connectable with heating which is extent which the solder which printed fuses by applying sufficient pressure for a solder ball and the solder for printing touching. Moreover, it becomes advantageous, when securing height to form the solder ball made from elevated-temperature solder.

[0037] In claim 7, since a conductive ingredient has spring nature or elasticity, it can fully be electrically stabilized by making it intervene between a semiconductor device tooth back and a semi-conductor carrier side in the condition of having sufficient elasticity tearing the oxide film on the rear face of a semiconductor device.

[0038] In claim 8, since thermosetting resin is poured into the gap of a semi-conductor carrier other than said semi-conductor carrier and it has the process to stiffen after connecting a semi-conductor carrier other than a semi-conductor carrier, it will be in the condition that the connection was stabilized and dependability will improve.

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## DESCRIPTION OF DRAWINGS

## [Brief Description of the Drawings]

[Drawing 1] It is the sectional view showing the structure of three steps of MCM of the semiconductor device of the gestalt of implementation of the 1st of this invention.

[Drawing 2] It is the top view of MCM of the three-step structure of drawing 1 .

[Drawing 3] It is the top view showing the structure of each semiconductor device which constitutes the semiconductor device of the gestalt of implementation of this invention.

[Drawing 4] It is a sectional view when cutting drawing 3 with A1-A2.

[Drawing 5] It is the process sectional view showing the manufacture approach of each semiconductor device of the gestalt implementation this invention.

[Drawing 6] It is the process sectional view showing the manufacture approach of three steps of MCM of the gestalt implementation of the 1st this invention.

[Drawing 7] It is the process sectional view of degree process of drawing 6 .

[Drawing 8] It is a top view explaining the structure of MCM of 2 tiering in the gestalt of implementation of the 2nd of this invention.

[Drawing 9] It is a sectional view when cutting drawing 8 with C1-C2.

[Drawing 10] It is the process sectional view showing the manufacture approach of two steps of MCM of the gestalt implementation of the 2nd this invention.

[Drawing 11] It is the process sectional view of degree process of drawing 10 .

[Drawing 12] It is the top view showing the structure of the conventional semiconductor device.

[Drawing 13] It is a sectional view when cutting drawing 12 with D1-D2.

[Drawing 14] It is the process sectional view showing the manufacture approach of the conventional semiconductor device.

[Drawing 15] It is the process sectional view of degree process of drawing 14 .

## [Description of Notations]

- 1 Semiconductor Device
- 2 Component Electrode
- 3 Semi-conductor Carrier
- 4 Electrode for Components
- 5 Bump
- 6 Electroconductive Glue
- 7 Closure Resin
- 8 Surface External Electrode
- 9 Rear-Face External Electrode
- 10 Semiconductor Device
- 11 Semi-conductor Carrier
- 12 Surface External Electrode
- 13 Rear-Face External Electrode
- 14 Semiconductor Device
- 15 Semi-conductor Carrier
- 16 Surface External Electrode
- 17 Rear-Face External Electrode
- 18 Solder Ball
- 19 Semiconductor Device
- 20 Semi-conductor Carrier
- 21 Surface External Electrode
- 22 Rear-Face External Electrode
- 23 Conductive Spring Material
- 24 Imprint Pan
- 25 Electroconductive Glue Film
- 27 Printing Solder
- 28 Welding Pressure
- 29 Semiconductor Device

30 Semiconductor Device  
31 Semi-conductor Carrier  
32 Surface External Electrode  
33 Rear-Face External Electrode  
34 Semiconductor Device  
35 Semi-conductor Carrier  
36 Surface External Electrode  
37 Rear-Face External Electrode  
38 Copper Ball  
39 Printing Solder  
40 Solder  
41 Anisotropy Conductive Liner Sheet  
42 Semiconductor Device  
43 Semiconductor Device  
44 Semiconductor Device  
45 Component Electrode  
46 Component Electrode  
47 Component Electrode  
48 Semi-conductor Carrier  
49 Electrode for Components  
50 Solder Ball  
51 Closure Resin  
52 GND Terminal  
53 Metal Coat  
54 Rear-Face External Electrode  
55 Resist  
56 Metal Coat

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[Translation done.]

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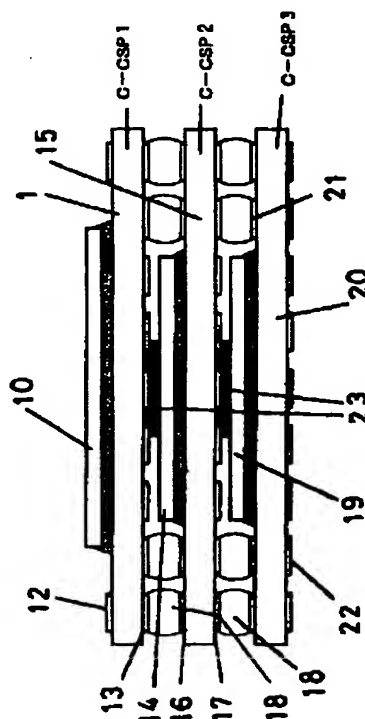
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(54) 【発明の名称】 半導体装置およびその製造方法

(57) 【要約】

【課題】 MCMの形態を取りつつ容易にバックバイアスをとることができ、プロセスコストを抑える。

【解決手段】 1あるいは複数の半導体素子14と、複数の半導体キャリア11、15と、半導体キャリア15上面の半導体素子用電極と半導体素子14の突起電極とを接続した導電性接着剤と、一方の半導体キャリア15上面の表面外部電極16と他方の半導体キャリア11底面の裏面外部電極13とを電気的に接続したはんだボール18と、一方の半導体キャリア15に接続した半導体素子14の背面と他方の半導体キャリア11底面の裏面外部電極13のうちのグランド端子とを電気的に接続した導電性ばね材23とを備えた。導電性ばね材23をバイアス付加することにより、高コスト設備工程や複雑なウェット工程を必要とすることなく、バックバイアス構造のMCMを提供することができる。



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## 【特許請求の範囲】

【請求項1】 複数の突起電極を有する1あるいは複数の半導体素子と、前記半導体素子の突起電極に対応する半導体素子用電極と前記半導体素子が存在しない位置に形成された表面外部電極とを上面に有し格子状に配列された裏面外部電極を底面に有した絶縁性基体からなる複数の半導体キャリアと、前記半導体キャリア上面の半導体素子用電極と前記半導体素子の突起電極とを接続した導電性接着剤と、前記半導体素子と前記半導体キャリアの間隙と前記半導体素子の周辺部を充填被覆している熱硬化性樹脂と、一方の前記半導体キャリア上面の表面外部電極と他方の前記半導体キャリア底面の裏面外部電極とを電気的に接続した接続用材料と、一方の前記半導体キャリアに接続した前記半導体素子の背面と他方の前記半導体キャリア底面の裏面外部電極のうちのグラウンド端子とを電気的に接続した導電性材料とを備えた半導体装置。

【請求項2】 接続用材料がはんだボールである請求項1記載の半導体装置。

【請求項3】 導電性材料がばね性あるいは伸縮性を有する請求項1記載の半導体装置。

【請求項4】 一方の半導体キャリア上面の表面外部電極と他方の半導体キャリア底面の裏面外部電極とを接続する接続用材料の付近のみ、もしくは一方の半導体キャリアと他方の半導体キャリアの間隙全体に樹脂材料が存在した請求項1、2または3記載の半導体装置。

【請求項5】 半導体素子の素子電極上に突起電極を形成する工程と、前記突起電極に導電性接着剤を供給する工程と、前記半導体素子上の前記導電性接着剤が供給された突起電極と、絶縁性基体からなる半導体キャリア上面に形成された前記半導体素子用電極とを接続し前記導電性接着剤を硬化する工程と、前記半導体素子と前記半導体キャリアとの間に形成された隙間と周辺部とに熱硬化性樹脂を注入し熱硬化させる工程と、前記半導体素子背面に導電性材料を搭載する工程と、前記半導体キャリア上面の表面外部電極と別の半導体キャリア底面の裏面外部電極とを接続用材料で電気的に接続し、前記導電性材料を別の半導体キャリア底面の裏面外部電極のうちのグラウンド端子に電気的に接続する工程とを含む半導体装置の製造方法。

【請求項6】 接続材料は、半導体キャリア上面の表面外部電極に印刷するはんだと、別の半導体キャリア底面の裏面外部電極に搭載するはんだボールとからなる請求項5記載の半導体装置の製造方法。

【請求項7】 導電性材料は、ばね性あるいは伸縮性を有する請求項5記載の半導体装置の製造方法。

【請求項8】 半導体キャリアと別の半導体キャリアを接続した後、前記半導体キャリアと別の半導体キャリアの間隙に熱硬化性樹脂を注入し、硬化させる工程を有する請求項5記載の半導体装置の製造方法。

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## 【発明の詳細な説明】

## 【0001】

【発明の属する技術分野】この発明は、半導体素子の集積回路部を保護し、かつ外部装置と半導体素子の電気的接続を安定に確保し、さらに最も高密度な実装を可能とするもので、とりわけ複数の半導体素子を搭載するマルチチップモジュール（以降MCM）に関し、情報通信機器、事務用電子機器、家庭用電子機器、測定装置、組立ロボット等の産業用電子機器、医療用電子機器、電子玩具等に使用される半導体装置およびその製造方法に関するものである。

## 【0002】

【従来の技術】以下従来の半導体装置について説明する。まず従来のバックバイアスを必要とするMCMの構造について説明する。図12および図13は従来のバックバイアスを必要とするMCMの構造を示した平面図と断面図である。そのMCMは3チップからなり、その中の1チップの背面にバックバイアス用の金属被膜を形成したものである。3個の半導体素子42、43、44の素子電極45、46、47は、半導体キャリア48の素子用電極49に対してはんだバンプ50等で電気的に接続されており、各半導体素子と半導体キャリア48との間隙には封止樹脂51が注入硬化されている（フリップチップ実装）。また、半導体キャリア48の表面にはGND電極（端子）52があり、このGND端子52と半導体素子43の裏面が電気的に接続されるように金属被膜53が形成されている。

【0003】次に従来のバックバイアスを必要とするMCMの製造方法について説明する。図14（a）～（c）、図15（d）～（f）は従来のバックバイアスを必要とするMCMの製造工程フローを示した工程断面図である。

【0004】半導体素子42、44の素子電極45、46上にはんだバンプ50を形成する（図14（a））。各半導体素子と半導体キャリア48を位置合わせて搭載後、リフロー等ではんだ接続を行う（図14（b））。各半導体素子と半導体キャリア48の間隙に封止樹脂51を注入し、硬化させる（図14（c））。バックバイアスを必要とする半導体素子43の背面と半導体キャリア48表側のGND端子52が電気的に接続するような開口部を有するようにMCMの表側にレジストマスク55を形成する（図15（d））。スパッタ等でMCMの表側に金属被膜56を形成する（図15（e））。つぎに形成したレジストマスク55を除去する（図15（f））。以上で、バックバイアスを必要とする半導体素子43と半導体キャリア48表面のGND端子52が電気的に接続されるように金属被膜53が形成されることになる。

【0005】以上のような工程をとることにより、バックバイアスを可能とする半導体素子を含むMCMを製造

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することができる。

#### 【0006】

【発明が解決しようとする課題】しかしながら従来のMCMではバックバイアスをとるためにMCM全体あるいはその一部に金属被膜を形成するが、プロセスとしてレジスト等によるマスクの形成やスパッタ等による金属蒸着を必要とするために、組み立て工程としてはかなり特別で、高コスト設備工程や複雑なウェット工程が必要となり、その結果としてコストアップの大きな原因となっている。

【0007】したがって、この発明の目的は、前記課題を解決するもので、MCMの形態を取りつつ容易にバックバイアスをとることのできる半導体装置およびその製造方法を提供することである。

#### 【0008】

【課題を解決するための手段】前記課題を解決するためにこの発明の請求項1記載の半導体装置は、複数の突起電極を有する1あるいは複数の半導体素子と、半導体素子の突起電極に対応する半導体素子用電極と半導体素子が存在しない位置に形成された表面外部電極とを上面に有し格子状に配列された裏面外部電極を底面に有した絶縁性基体からなる複数の半導体キャリアと、半導体キャリア上面の半導体素子用電極と半導体素子の突起電極とを接続した導電性接着剤と、半導体素子と半導体キャリアの間隙と半導体素子の周辺部を充填被覆している熱硬化性樹脂と、一方の半導体キャリア上面の表面外部電極と他方の半導体キャリア底面の裏面外部電極とを電気的に接続した接続用材料と、一方の半導体キャリアに接続した半導体素子の背面と他方の半導体キャリア底面の裏面外部電極のうちのグランド端子とを電気的に接続した導電性材料とを備えた。

【0009】このように、一方の半導体キャリア上面の半導体素子用電極と半導体素子の突起電極とを導電性接着剤で接続したので、一方の半導体キャリア上面から半導体素子背面までの半導体素子の高さ寸法を小さくできる。これに伴い、一方の半導体キャリア上面の表面外部電極と他方の半導体キャリア底面の裏面外部電極とを電気的に接続した接続用材料の高さは半導体素子の上記高さ寸法よりも十分に大きくなる。このため、半導体素子の背面側に他方の半導体キャリアを位置させて、一方の半導体キャリアに接続した半導体素子の背面と他方の半導体キャリア底面の裏面外部電極のうちのグランド端子とを導電性材料で電気的に接続することで、バックバイアスを必要とするMCMにおいて、レジスト等によるマスクング及び蒸着法による金属被膜の形成など複雑な加工工程を必要とすることなく、低コストでバックバイアス構造をとることを可能とした。

【0010】請求項2記載の半導体装置は、請求項1において、接続用材料がはんだボールである。このように、接続用材料がはんだボールであるので、高温はんだ

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製のはんだボールを形成することが高さを確保する上で有利となる。

【0011】請求項3記載の半導体装置は、請求項1において、導電性材料がばね性あるいは伸縮性を有する。このように、導電性材料がばね性あるいは伸縮性を有するので、半導体素子裏面の酸化膜を破るのに十分な弾性を有する状態で半導体素子背面と半導体キャリア裏面の間に介在させることにより電気的に十分に安定させることができる。

10 【0012】請求項4記載の半導体装置は、請求項1、2または3において、一方の半導体キャリア上面の表面外部電極と他方の半導体キャリア底面の裏面外部電極とを接続する接続用材料の付近のみ、もしくは一方の半導体キャリアと他方の半導体キャリアの間隙全体に樹脂材料が介在した。このように、一方の半導体キャリア上面の表面外部電極と他方の半導体キャリア底面の裏面外部電極とを接続する接続用材料の付近のみ、もしくは一方の半導体キャリアと他方の半導体キャリアの間隙全体に樹脂材料が介在したので、接続部が安定した状態となり信頼性が向上する。

20 【0013】請求項5記載の半導体装置の製造方法は、半導体素子の素子電極上に突起電極を形成する工程と、突起電極に導電性接着剤を供給する工程と、半導体素子上の導電性接着剤が供給された突起電極と、絶縁性基体からなる半導体キャリア上面に形成された半導体素子用電極とを接続し導電性接着剤を硬化する工程と、半導体素子と半導体キャリアとの間に形成された隙間と周辺部とに熱硬化性樹脂を注入し熱硬化させる工程と、半導体素子背面に導電性材料を搭載する工程と、半導体キャリア上面の表面外部電極と別の半導体キャリア底面の裏面外部電極とを接続用材料で電気的に接続し、導電性材料を別の半導体キャリア底面の裏面外部電極のうちのグランド端子に電気的に接続する工程とを含む。

30 【0014】このように、半導体素子上の導電性接着剤が供給された突起電極と、半導体キャリア上面に形成された半導体素子用電極とを接続し導電性接着剤を硬化するので、半導体キャリア上面から半導体素子背面までの半導体素子の高さ寸法を小さくできる。そのため、半導体素子背面に導電性材料を搭載して、半導体キャリア上面の表面外部電極と別の半導体キャリア底面の裏面外部電極とを接続用材料で電気的に接続する際、この接続用材料の高さは半導体素子の上記高さ寸法よりも十分に大きくなる。これにより、半導体素子の背面側に別の半導体キャリアを位置させて、半導体素子の背面と別の半導体キャリア底面の裏面外部電極のうちのグランド端子とを導電性材料で電気的に接続することができるので、バイアスを付加させる構造にする際、マスクングなどの複雑な工程や金属蒸着のように設備コストの高い工程を必要とすることなく、容易で安価なプロセスをとることができるので、さらに3次的にデバイスを積み重ねるので、

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面積的には非常に高い実装密度で半導体素子を搭載した MCM を提供することができる。

【0015】請求項 6 記載の半導体装置の製造方法は、請求項 5 において、接続材料は、半導体キャリア上面の表面外部電極に印刷するはんだと、別の半導体キャリア底面の裏面外部電極に搭載するはんだボールとからなる。このように、接続材料は、半導体キャリア上面の表面外部電極に印刷するはんだと、別の半導体キャリア底面の裏面外部電極に搭載するはんだボールとからなるので、印刷を行ったはんだが溶融する程度の加熱と、はんだボールと印刷用はんだが接するのに十分な圧力を加えることで接続できる。また、高温はんだ製のはんだボールを形成することが高さを確保する上で有利となる。

【0016】請求項 7 記載の半導体装置の製造方法は、請求項 5 において、導電性材料は、ばね性あるいは伸縮性を有する。このように、導電性材料は、ばね性あるいは伸縮性を有するので、半導体素子裏面の酸化膜を破るのに十分な弾性を有する状態で半導体素子背面と半導体キャリア裏面の間に介在させることにより電氣的に十分に安定させることができる。

【0017】請求項 8 記載の半導体装置の製造方法は、請求項 5 において、半導体キャリアと別の半導体キャリアを接続した後、半導体キャリアと別の半導体キャリアの間に熱硬化性樹脂を注入し、硬化させる工程を有する。このように、半導体キャリアと別の半導体キャリアを接続した後、半導体キャリアと別の半導体キャリアの間に熱硬化性樹脂を注入し、硬化させる工程を有するので、接続部が安定した状態となり信頼性が向上する。

【0018】

【発明の実施の形態】この発明の第 1 の実施の形態を図 1～図 7 に基づいて説明する。第 1 の実施の形態は基本的に個々の半導体デバイスを 3 段構造に積み上げることにより MCM の構造をとるものである。図 1 はこの発明の第 1 の実施の形態の半導体装置の 3 段の MCM の構造を示し、図 2 を B 1－B 2 で切ったときの断面図である。図 2 は 3 段構造の MCM の平面図、図 3 はこの発明の実施の形態の半導体装置を構成する個々の半導体デバイスの構造（以降 C－CSP と称する）を示す平面図、図 4 は図 3 を A 1－A 2 で切った時の断面図である。

【0019】図 1～図 4 に示すようにこの半導体装置は、複数の突起電極（Au パンプ 5）を有する 1 あるいは複数の半導体素子 1 と、半導体素子 1 の突起電極 5 に対応する半導体素子用電極 4 と半導体素子 1 が存在しない位置に形成された表面外部電極 8 とを上面に有し格子状に配列された裏面外部電極 9 を底面に有した絶縁性基体からなる複数の半導体キャリア 3 と、半導体キャリア 3 上面の半導体素子用電極 4 と半導体素子 1 の突起電極 5 とを接続した導電性接着剤 6 と、半導体素子 1 と半導体キャリア 3 の間隙と半導体素子 1 の周辺部を充填被覆している熱硬化性樹脂（封止樹脂 7）とを備えている。

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また、一方の半導体キャリア 1 5 上面の表面外部電極 1 6 と他方の半導体キャリア 1 1 底面の裏面外部電極 1 3 とを電氣的に接続した接続用材料（はんだボール 1 8）と、一方の半導体キャリア 1 5 に接続した半導体素子 1 4 の背面と他方の半導体キャリア 1 1 底面の裏面外部電極 1 3 のうちのグランド端子とを電氣的に接続した導電性材料（導電性ばね材 2 3）とを備えている。

【0020】まず図 3 および図 4 を用いてこの実施形態における MCM を構成する C－CSP（セラミックをインターポーザとする LGA）の半導体素子と半導体キャリアの接続構造について説明する。半導体素子 1 の素子電極 2 と半導体キャリア 3 の素子用電極 4 は Au パンプ 5 と導電性接着剤 6 とを介して電氣的に接続されており、さらに半導体素子 1 と半導体キャリア 3 の間隙には封止樹脂 7 が注入硬化されている（以降この接続方式を SBB 方式と称する）。この時、半導体キャリア 3 の素子用電極 4 は回路構成上の必要に応じて半導体キャリア 3 の表面外部電極 8 と裏面外部電極 9 と電氣的に接続されている。さらに半導体素子 1 は、積層させるときに用いる接続材料の高さよりも十分に小さい厚さを有するものである。

【0021】次に図 1 および図 2 を用いてこの実施形態における 3 段積みの MCM の構造について説明する。図 1 および図 2 において、上段の半導体装置を C－CSP 1（裏面電位を必要としない半導体素子 1 0 を搭載）、中段を C－CSP 2（裏面電位を必要とする半導体素子 1 4 を搭載）、下段を C－CSP 3（裏面電位を必要とする半導体素子 1 9 を搭載）とし、すべての C－CSP が図 3 および図 4 における接続構造により半導体素子と半導体キャリアが接続されている。C－CSP 1 における半導体キャリア 1 1 の裏面外部電極 1 3 のうち外周 2 列分と C－CSP 2 における半導体キャリア 1 5 の表面外部電極 1 6 とが、さらに C－CSP 2 における半導体キャリア 1 5 の裏面外部電極 1 7 のうち外周 2 列分と C－CSP 3 における半導体キャリア 2 0 の表面外部電極 2 1 とがはんだボール 1 8 でそれぞれ接続されている。この時はんだボール 1 8 の高さはそれぞれの C－CSP における半導体キャリア上面から半導体素子背面までの距離よりも十分に大きく、そのためには高温はんだ製のはんだボールを形成することが有利となる。また C－CSP 1 における半導体キャリア 1 1 の裏面外部電極 1 3 のうちの GND 端子と C－CSP 2 における半導体素子 1 4 の背面とが導電性ばね材（金属）2 3 で電氣的に接続され、さらに C－CSP 2 における半導体キャリア 1 5 の裏面外部電極 1 7 のうちの GND 端子と C－CSP 3 の半導体素子 1 9 の背面とが導電性ばね材 2 3 で電氣的に接続されている。この時、導電性ばね材 2 3 を半導体素子 1 4、1 9 背面のシリコン酸化膜を破るのに十分な弾性を有する状態でそれぞれの半導体素子 1 4、1 9 背面と半導体キャリア 1 1、1 5 裏面の間に介在させ

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ることにより、電氣的に十分に安定させることができる。また、これは半導体素子14、19の背面にあらかじめ金属薄膜を形成させておいてもより小さい弾性力で十分な効果を得ることができる。なお、導電性ばね材23の具体例としては、電気抵抗の低い銅系合金（リン青銅（91.7Cu-8.2Sn）、真ちゅう（62.3Cu-37.0Zn）、ベリリウム銅、洋白）、その他、コバルト系合金、ニッケル系合金等がある。

【0022】次に図5および図7を用いて第1の実施形態における3段構造MCMの製造方法について説明する。図5はこの発明の実施の形態の個々の半導体装置（C-CSP）の製造方法を示す工程断面図、図6および図7はこの発明の第1の実施の形態の3段のMCMの製造方法を示す工程断面図である。

【0023】まず図5を用いて個々のC-CSPの製造方法について説明する。半導体素子1の素子電極2上にAuパンプ5を形成する（図5（a））。次に十分な平坦性を有する転写皿24に均一な膜厚を有する導電性接着剤膜25を形成し、半導体素子1のAuパンプ5をフェイスタウンで導電性接着剤膜25に浸漬させ、適量の導電性接着剤6をAuパンプ5に転写させる（図5

（b））。Auパンプ5と半導体キャリア3の素子用電極4とが導電性接着剤6を介して接続されるように半導体素子1と半導体キャリア3を位置あわせし、マウント後導電性接着剤6を熱硬化させる（図5（c））。次に、半導体素子1と半導体キャリア3の間隙に封止樹脂7を注入、熱硬化させる（図5（d））。

【0024】次に図6および図7を用いてMCMの製造方法について説明する。C-CSP1における半導体キャリア11の裏面外部電極13及びC-CSP2における半導体キャリア15における裏面外部電極17にはんだボール18を形成する（図6（a））。はんだボールを形成する方法としては、印刷法あるいはボールマウント法などを用いる。次にC-CSP2における半導体キャリア15の表面外部電極16上とC-CSP3における半導体キャリア20の表面外部電極21上にはんだ27を印刷する（図6（b））。印刷するはんだとしてははんだボールよりも融点の低いものを用いることにより、はんだボールの高さを稼ぐことができ有利である。次にC-CSP2における半導体素子14の背面とC-CSP3における半導体素子21の背面に導電性のばね材23を載せる（図7（c））。この時この導電性ばね材23が、C-CSP1における半導体キャリア11の裏面外部電極13のうちGND端子だけに、またC-CSP2における半導体キャリア15の裏面外部端子17のうちGND端子だけに接続するような位置に載せる。最後にC-CSP2をC-CSP1に、C-CSP3をC-CSP2に位置合わせ搭載し、印刷を行ったはんだ27が熔融する程度の加熱と、それぞれのはんだボール18と印刷用はんだ27が接するのに十分な圧力28を

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加えることによりMCMを形成する（図7（d））。これにより、導電性ばね材23に電氣的接続を安定に行うのに十分な弾性力を与えることが可能になる。

【0025】以上のように第1の実施形態におけるMCMの構造及び製造方法をとることにより、マスク形成やその剥離という複雑な工程や、金属蒸着といった設備コストの高い工程を用いることなく安定的に半導体素子の裏面にバイアスを負荷させることができる半導体装置とその製造方法を提供することができる。

【0026】またこの構造は回路設計的に可能な範囲で、第1の実施形態における個々の半導体装置を無数に積み上げることができ、ある一定の平面に多くの半導体素子をモジュール化することが可能である。

【0027】この発明の第2の実施の形態を図8～図11に基づいて説明する。図8はこの発明の第2の実施の形態における2段積みのMCMの構造を説明する平面図、図9は図8をC1-C2で切ったときの断面図である。

【0028】図8および図9に示すようにこの半導体装置の構成は、裏面バイアスを必要とする半導体素子34を1個搭載したC-CSP4を下段に必要としない半導体素子29、30を2個載せたC-MCMを上段に配置したものである。またC-CSP4、C-MCMにおける半導体素子と半導体キャリアの接続はSBB方式にて行われている。上段に位置するC-MCMにおける半導体キャリア31の裏面外部電極33のうち外周2列が下段に位置するC-CSP4における半導体キャリア35の表面外部電極36は銅ボール38とはんだ39、40により接続されている。また下段に位置するC-CSP4における半導体素子34の背面と上段に位置するC-MCMにおける半導体キャリア31の裏面外部電極33のうちのGND端子とが異方性導電性シート41によって電氣的に接続されている。そして上段のC-MCMと下段のC-CSP4との間隙には封止樹脂51が注入硬化されている。

【0029】次に図10および図11を用いて第2の実施形態におけるMCMの製造方法について説明する。図10および図11はこの発明の第2の実施の形態の2段のMCMの製造方法を示す工程断面図である。C-MCMをSBB接続により製造後、C-MCMにおける半導体キャリア31の裏面外部電極32にはんだ39を印刷し、銅ボール38を搭載後リフロー等により銅ボール38を接続させる（図10（a））。次にC-CSP4における半導体キャリア35の表面外部電極36にはんだ40を印刷後（図10（b））、半導体素子34の背面に異方性導電性シート41を貼り付ける（図11

（c））。次にC-MCMとC-CSP4を位置合わせしC-MCMをC-CSP4にマウントする。この時、加圧・加熱をしてC-CSP4の半導体素子34の背面とC-MCMの裏面外部電極33のうちのGND端子と



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を電氣的に接続する(図11(d))。その後リフロー等により、はんだ40によりはんだボール38とC-CSP4における半導体キャリア35の表面外部電極36が電氣的に接続される。つぎに、C-CSP4とC-MCMとの間隙に加熱しながらエポキシ性の樹脂42を注入後、オープン等で熱硬化させる(図11(e))。

【0030】以上のように第2の実施形態によれば、第1の実施形態におけるMCMと同様に簡易な方法で裏面バイアスを必要とする半導体素子をMCM化することができる。さらに第2の実施形態では、それぞれのC-CSP、あるいはC-MCMの間隙に樹脂を注入硬化させることにより、より信頼性の高いMCMを提供することができる。

【0031】

【発明の効果】この発明の請求項1記載の半導体装置によれば、一方の半導体キャリア上面の半導体素子用電極と半導体素子の突起電極とを導電性接着剤で接続したので、一方の半導体キャリア上面から半導体素子背面までの半導体素子の高さ寸法を小さくできる。これに伴い、一方の半導体キャリア上面の表面外部電極と他方の半導体キャリア底面の裏面外部電極とを電氣的に接続した接続用材料の高さは半導体素子の高さ寸法よりも十分に大きくなる。このため、半導体素子の背面側に他方の半導体キャリアを位置させて、一方の半導体キャリアに接続した半導体素子の背面と他方の半導体キャリア底面の裏面外部電極のうちのグランド端子とを導電性材料で電氣的に接続することで、バックバイアスを必要とするMCMにおいて、レジスト等によるマスキング及び蒸着法による金属被膜の形成など複雑な加工工程を必要とすることなく、低コストでバックバイアス構造をとることを可能とした。

【0032】請求項2では、接続用材料がはんだボールであるので、高温はんだ製のはんだボールを形成することが高さを確保する上で有利となる。

【0033】請求項3では、導電性材料がばね性あるいは伸縮性を有するので、半導体素子裏面の酸化膜を破るのに十分な弾性を有する状態で半導体素子背面と半導体キャリア裏面の間に介在させることにより電氣的に十分に安定させることができる。

【0034】請求項4では、一方の半導体キャリア上面の表面外部電極と他方の半導体キャリア底面の裏面外部電極とを接続する接続用材料の付近のみ、もしくは一方の半導体キャリアと他方の半導体キャリアの間隙全体に樹脂材料が介在したので、接続部が安定した状態となり信頼性が向上する。

【0035】この発明の請求項5記載の半導体装置の製造方法によれば、半導体素子上の導電性接着剤が供給された突起電極と、半導体キャリア上面に形成された半導体素子用電極とを接続し導電性接着剤を硬化するので、半導体キャリア上面から半導体素子背面までの半導体素

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子の高さ寸法を小さくできる。そのため、半導体素子背面に導電性材料を搭載して、半導体キャリア上面の表面外部電極と別の半導体キャリア底面の裏面外部電極とを接続用材料で電氣的に接続する際、この接続用材料の高さは半導体素子の上記高さ寸法よりも十分に大きくなる。これにより、半導体素子の背面側に別の半導体キャリアを位置させて、半導体素子の背面と別の半導体キャリア底面の裏面外部電極のうちのグランド端子とを導電性材料で電氣的に接続することができるので、バイアスを付加させる構造にする際、マスキングなどの複雑な工程や金属蒸着のように設備コストの高い工程を必要とすることなく、容易で安価なプロセスをとることができる。さらに3次元的にデバイスを積み重ねるので、面積的には非常に高い実装密度で半導体素子を搭載したMCMを提供することができる。

【0036】請求項6では、接続材料は、半導体キャリア上面の表面外部電極に印刷するはんだと、別の半導体キャリア底面の裏面外部電極に搭載するはんだボールとからなるので、印刷を行ったはんだが熔融する程度の加熱と、はんだボールと印刷用はんだが接するのに十分な圧力を加えることで接続できる。また、高温はんだ製のはんだボールを形成することが高さを確保する上で有利となる。

【0037】請求項7では、導電性材料は、ばね性あるいは伸縮性を有するので、半導体素子裏面の酸化膜を破るのに十分な弾性を有する状態で半導体素子背面と半導体キャリア裏面の間に介在させることにより電氣的に十分に安定させることができる。

【0038】請求項8では、半導体キャリアと別の半導体キャリアを接続した後、前記半導体キャリアと別の半導体キャリアの間隙に熱硬化性樹脂を注入し、硬化させる工程を有するので、接続部が安定した状態となり信頼性が向上する。

【図面の簡単な説明】

【図1】この発明の第1の実施の形態の半導体装置の3段のMCMの構造を示す断面図である。

【図2】図1の3段構造のMCMの平面図である。

【図3】この発明の実施の形態の半導体装置を構成する個々の半導体デバイスの構造を示す平面図である。

【図4】図3をA1-A2で切った時の断面図である。

【図5】この発明の実施の形態の個々の半導体装置の製造方法を示す工程断面図である。

【図6】この発明の第1の実施の形態の3段のMCMの製造方法を示す工程断面図である。

【図7】図6の次工程の工程断面図である。

【図8】この発明の第2の実施の形態における2段積みのMCMの構造を説明する平面図である。

【図9】図8をC1-C2で切ったときの断面図である。

【図10】この発明の第2の実施の形態の2段のMCM

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の製造方法を示す工程断面図である。

【図11】図10の次工程の工程断面図である。

【図12】従来の半導体装置の構造を示す平面図である。

【図13】図12をD1-D2で切った時の断面図である。

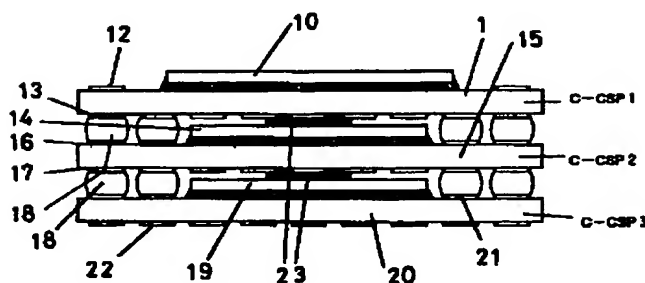
【図14】従来の半導体装置の製造方法を示す工程断面図である。

【図15】図14の次工程の工程断面図である。

【符号の説明】

- 1 半導体素子
- 2 素子電極
- 3 半導体キャリア
- 4 素子用電極
- 5 パンプ
- 6 導電性接着剤
- 7 封止樹脂
- 8 表面外部電極
- 9 裏面外部電極
- 10 半導体素子
- 11 半導体キャリア
- 12 表面外部電極
- 13 裏面外部電極
- 14 半導体素子
- 15 半導体キャリア
- 16 表面外部電極
- 17 裏面外部電極
- 18 はんだボール
- 19 半導体素子
- 20 半導体キャリア
- 21 表面外部電極
- 22 裏面外部電極
- 23 導電性ばね材

【図1】

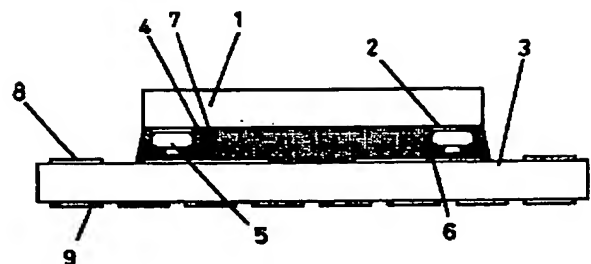


- |              |              |
|--------------|--------------|
| 10...半導体素子   | 17...裏面外部電極  |
| 11...半導体キャリア | 18...はんだボール  |
| 12...表面外部電極  | 19...半導体素子   |
| 13...裏面外部電極  | 20...半導体キャリア |
| 14...半導体素子   | 21...表面外部電極  |
| 15...半導体キャリア | 22...裏面外部電極  |
| 16...表面外部電極  | 23...導電性ばね材  |

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- 24 転写皿
- 25 導電性接着剤膜
- 27 印刷はんだ
- 28 加圧力
- 29 半導体素子
- 30 半導体素子
- 31 半導体キャリア
- 32 表面外部電極
- 33 裏面外部電極
- 34 半導体素子
- 35 半導体キャリア
- 36 表面外部電極
- 37 裏面外部電極
- 38 銅ボール
- 39 印刷はんだ
- 40 はんだ
- 41 異方性導電性シート
- 42 半導体素子
- 43 半導体素子
- 44 半導体素子
- 45 素子電極
- 46 素子電極
- 47 素子電極
- 48 半導体キャリア
- 49 素子用電極
- 50 はんだボール
- 51 封止樹脂
- 52 GND端子
- 53 金属被膜
- 54 裏面外部電極
- 55 レジスト
- 56 金属被膜

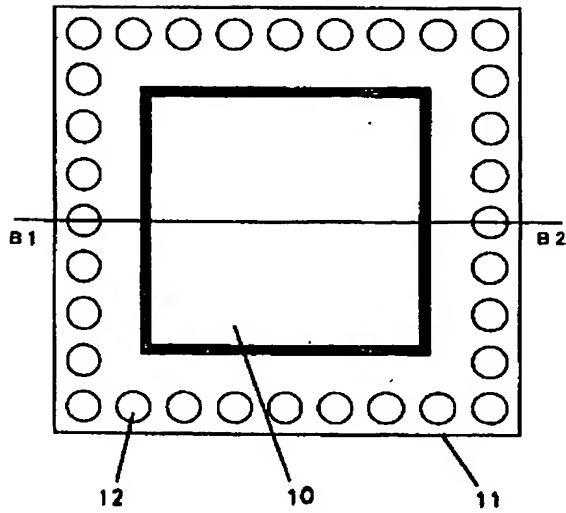
【図4】



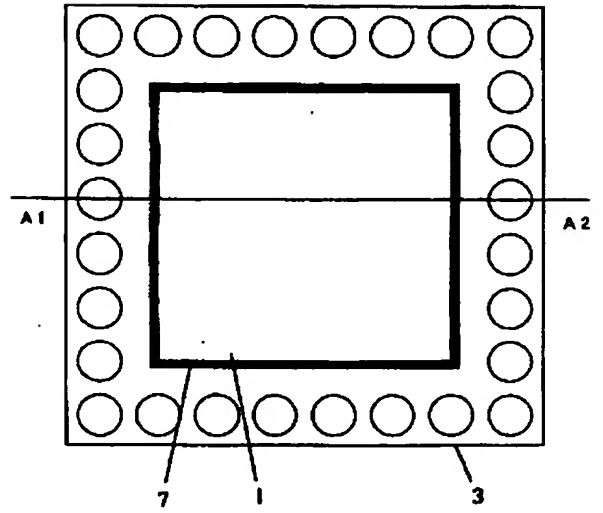
- |             |            |
|-------------|------------|
| 1...半導体素子   | 6...導電性接着剤 |
| 2...素子電極    | 7...封止樹脂   |
| 3...半導体キャリア | 8...表面外部電極 |
| 4...素子用電極   | 9...裏面外部電極 |
| 5...Auパンプ   |            |

(8)

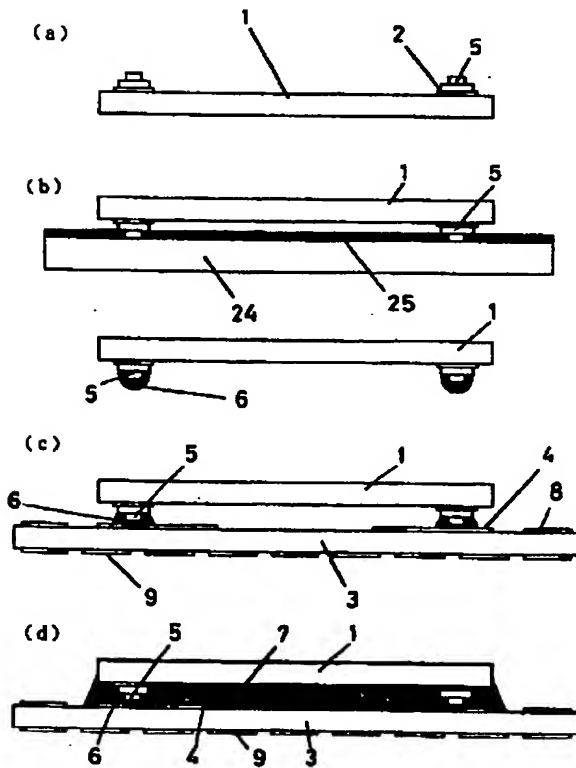
【図2】



【図3】

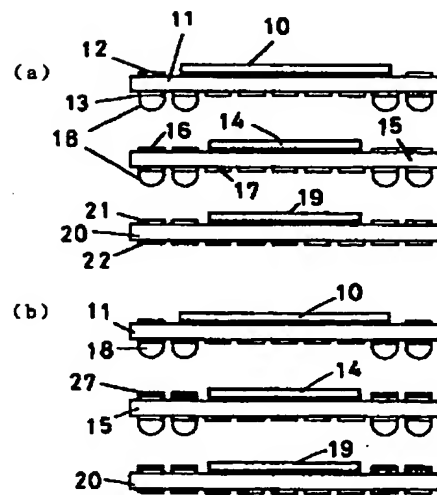


【図5】



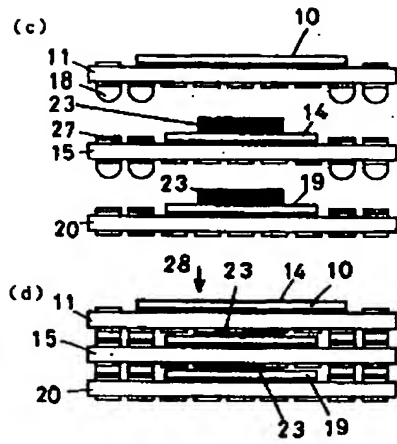
6...導電性接着剤  
24...導電性接着剤  
25...導電性接着剤

【図6】

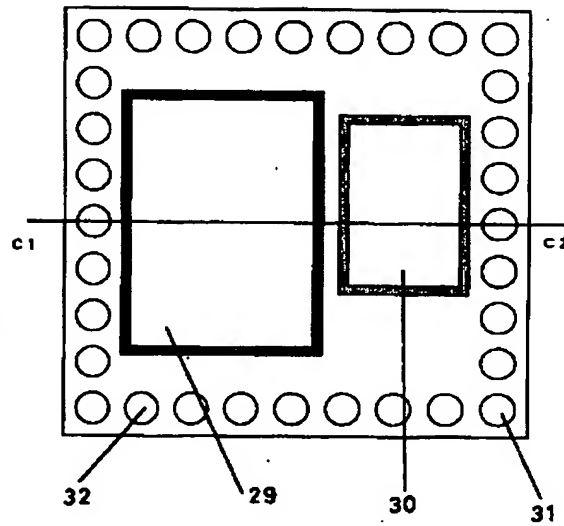


(9)

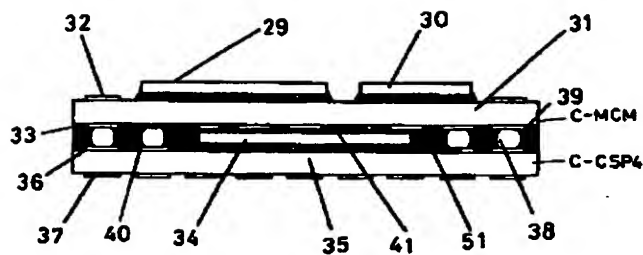
【図 7】



【図 8】

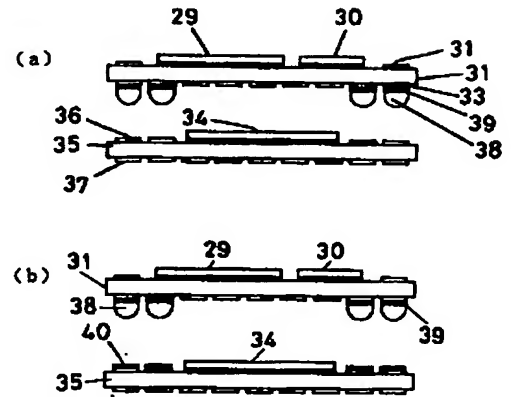


【図 9】

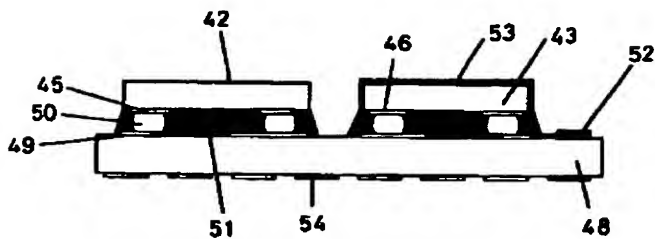


- |              |                |
|--------------|----------------|
| 30...半導体素子   | 37...基面外部電極    |
| 31...半導体キャリア | 38...銅ボール      |
| 32...表面外部電極  | 39...はんだ       |
| 33...基面外部電極  | 40...はんだ       |
| 34...半導体素子   | 41...導力性導電性シート |
| 35...半導体キャリア | 51...封止樹脂      |
| 36...表面外部電極  |                |

【図 10】



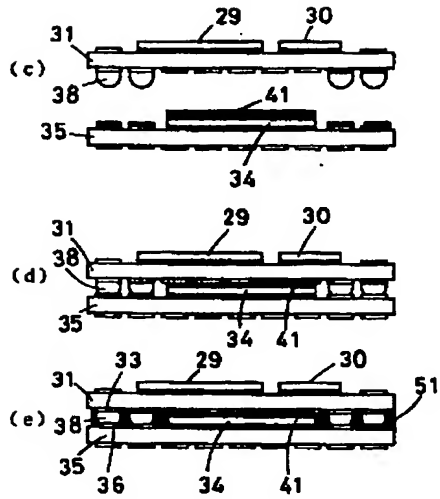
【図 13】



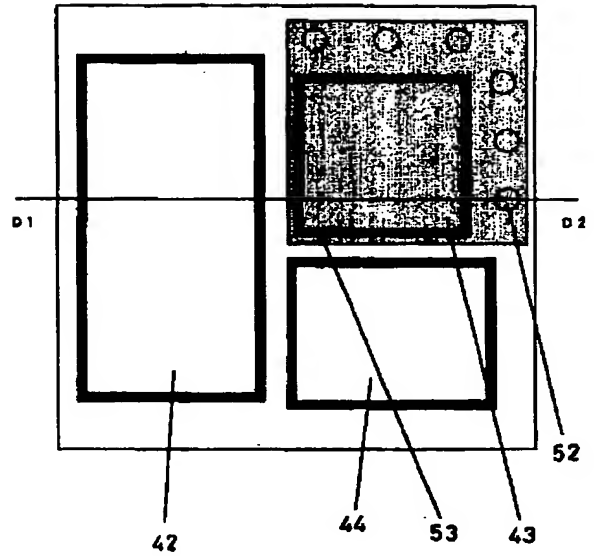
- |              |             |
|--------------|-------------|
| 43...半導体素子   | 50...はんだバンプ |
| 45...素子用電極   | 51...封止樹脂   |
| 46...素子用電極   | 52...CND端子  |
| 48...半導体キャリア | 53...金属板    |
| 49...素子用電極   | 54...表面外部端子 |

(10)

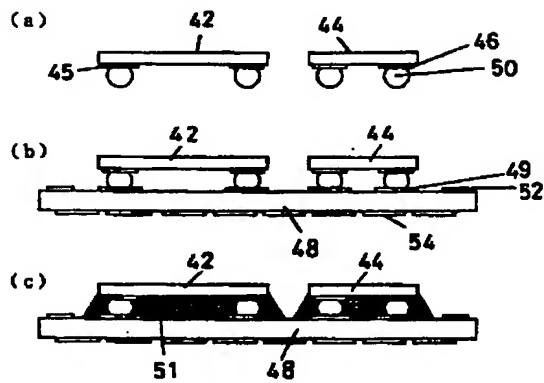
【図11】



【図12】

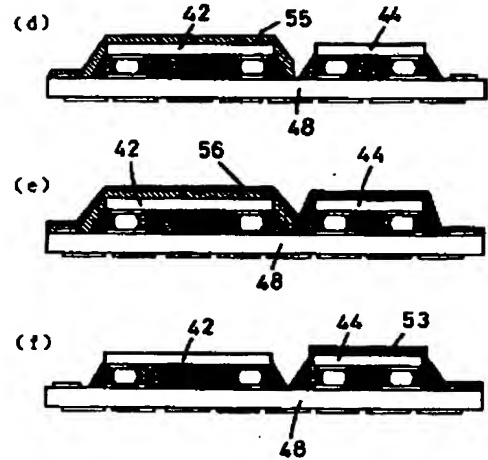


【図14】



42...半導体素子	48...素子用電極
44...半導体素子	50...はんだパンプ
46...素子用電極	51...封止樹脂
48...素子用電極	52...GND端子
48...半導体キャリア	54...裏面外部端子

【図15】



56...レジストマスク  
58...金属蒸着膜

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